

REMARKS

By this amendment, Applicants have amended claims 1-4 and 6-18 to be directed a piston ring, i.e., by inserting therein the limitations previously recited in claims 19-21. Accordingly, claims 19-21 have been canceled without prejudice or disclaimer. See, e.g., page 1, lines 2 and 3 of Applicants' specification.

Since the Examiner has already considered the limitations added to claims 1-4 and 6-18 in connection with claims 19-21, the foregoing amendments do not raise new issues requiring further consideration and/or search. Moreover, the foregoing amendments place the application in condition for allowance for the reasons set forth hereinafter. Therefore, entry of this amendment under 37 CFR 1.116 is requested.

Claims 1, 3, 4 and 6-10 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,562,786 to Hayashi et al. in view of U.S. Patent No. 3,343,953 to Schladitz. Applicants traverse this rejection and request reconsideration thereof.

The present invention relates to a piston ring made of a particular material. The material consists of a steel comprising, by mass, from not less than 0.4 % to less than 1.3 % of C (carbon), 0.1 to 3.0 % of Si, 0.1 to 3.0 % of Mn, from zero (inclusive) to 0.5 % of Cr, 0.05 to 3.0 % of Ni, 0.7 to 2.0 % of Al, 0.3 to 20 % in total (Mo + W + V) of at least one element selected from the group consisting of Mo, W (tungsten) and V (vanadium), and 0.05 to 3.0 % of Cu, wherein there can be observed graphite particles having an average particle size of not more than 3 μ m in a section of a metal structure of a steel.

The Hayashi et al. patent relates to a process for producing a heat-treated sintered iron alloy part having enhanced strength and hardness and, in particular, excellent dimensional accuracy, by heat-treating an iron-based sinter obtained by powder metallurgy. The use of the material in oil pumps is mentioned. See, e.g., column 1, lines 65-67 and Example 3 at column 7, line 10 et seq. of Hayashi et al. While Example 1 of this patent discloses compacting the mixed powder into a ring-shape, there is no disclosure that the material should be used for a piston ring.

Moreover, the Hayashi et al. patent does not describe a piston ring including observed graphite particles having an average particle size of not more than 3 μm in a section of a metal structure of the steel.

The Schladitz patent relates to self-lubricating sliding and bearing materials comprising a dry lubricant such as metal sulfides, metal oxides, graphite or the like and to methods of manufacturer of such materials. It is disclosed that the material can be manufactured in thin flexible layers, films or strips by incorporating the lubricant particles in a frame work, for instance a thin bronze lattice, and by connecting the particles to the frame work by means of metallization. The material formed in this way can than be rolled up to form rolls, the individual layers of which can be interconnected by one of several methods such as a sintered, gluing or metal-ceramic process to form compact bodies. Such rolls can be used in the same manner as composite bearings for mounting and bearing bushings. Furthermore, the layers can be glued to rigid supporting surfaces to form sliding surfaces. Thus, Schladitz teaches using the material on the surface of another material. However, clearly there is no disclosure in Schladitz that would provide any reason for one ordinary skill in the art to make the sintered iron alloy of Hayashi et al. one having observed graphite particles having an average particle size of not more than 3 μm .

Moreover, clearly there would have been no reason to modify the teachings of Hayashi et al. or Schladitz et al. to use the material of Hayashi et al. as a piston ring. Accordingly, the presently claimed invention is patentable over the proposed combination of references.

Claims 1-4 and 7-10 stand rejected under 35 U.S.C. 103(a) as being unpatentable over JP-09-013142 to Kawabata et al. in view of JP-07-188847 to Iwamoto et al. Applicants traverse this rejection and request reconsideration thereof.

The Kawabata et al. publication discloses a graphite precipitated hot rolled steel sheet excellent in bending workability and heat treatability and a method for its production. In the first place, it does not appear that this document discloses a piston ring. Moreover, as recognized by the Examiner, this document does not disclose a steel including 0.3 to 20% in total (Mo+W+V) of at least one element selected from the group consisting of Mo+W+V.

The Iwamoto et al. document discloses a steel having an aluminum content of 0.01 to 0.5% by mass. While the Examiner relies on this document for its teachings in connection with the molybdenum content, it is not clear why one would rely on this document only for its molybdenum content and not modify the steel of Kawabata et al. to also include the aluminum content of the Iwamoto et al., which is outside the presently claimed range. In any event, it is submitted even the combined teachings of Kawabata et al. and Iwamoto et al. would not have suggested using the steel to form a piston ring. Accordingly, claims 1-4 and 7-10 are patentable over the proposed combination of Kawabata et al. and the Iwamoto et al.

Claims 11-21 stand rejected under 35 U.S.C 103(a) as being unpatentable over Kawabata et al. in view of Iwamoto et al. and further in view of U.S. Patent No.

2,014,440 to Lee. Applicants traverse this rejection and request reconsideration thereof.

The patent to Lee discloses a method of heat treated piston rings.

The Office Action states that Lee discloses that carbon steel containing 0.8-0.9 wt% carbon would be preferred for piston rings, and that rings having 0.8-0.9 wt% carbon would perform satisfactorily with respect to elasticity, toughness, and high temperatures (see page 9 of the Office Action).

The presently claimed steel containing graphite particles is clearly distinguished from the carbon steel of Lee in chemical composition, metal structure and technical advantages. In the present invention, graphite particles provide the steel with anti-seizure resistance property. According to the present invention, in order to enhance smooth formation of graphite particles, particular elements of Ni, Al and Cu are added to carbon steel.

Lee is directed to a mere carbon steel containing 0.8 to 0.9 % carbon preferred for piston rings, which has no self-lubrication property.

Thus, while Lee discloses that the carbon steel described therein can be used for piston rings, there is no suggestion that other steels should be used for piston rings or that other steels should be modified to provide self-lubricating property and used as piston rings.

Thus, there would have been no apparent reason for one of ordinary skill in the art to have used the steel of Kawabata et al., whether or not modified by the Iwamoto et al., as a piston ring. The graphite precipitated steel of Kawabata et al. is different than that of Lee such that there would have been no reason to interchange the steel of Kawabata et al. for that of Lee or to use the steel of Kawabata et al. as a piston ring.

For the foregoing reasons, the presently claimed invention is patentable over the proposed combination of references.

In view of the foregoing amendments and remarks, entry of this amendment and favorable reconsideration and allowance of all of the claims now in the application are requested.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 500.44577X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

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